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ABSTRACT

Procedures are outlined for aiding students in clarifying values and making decisions. Activities are included which were selected to sensitize students to some current situations that involve making technological, scientific, or bicethical decisions. The five activities are concerned with the following problematic situations: (1) government control of population, (2) recombinant DNA research, (3) nuclear and atomic energy, (4) prevention of Downs' syndrome by abortion, and (5) fossil fuel conservation. (CS)

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Decision-Making Concerning Ethical Issues of Science and Technology--A Series of Activities

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For the past decade and perhaps longer, the United States' citizens have expressed two views of science and technology. The first view has been exemplified by the anti-science movement, especially strong in the early seventies. The belief basic to this movement is that science and technology, with no separation of the two, are to blame for the energy crisis, pollution, and many other world problems. The feeling has been that since science and technology are to blame, people should turn away from both. The second view is quite the opposite. Accordingly, many believe science and technology are all powerful and can solve all world problems. They look at the great scientific and technological advances surrounding them and see no reason why science and its use can't solve the energy crisis, pollution, and more. Both views are dangerous to the continued existence of the world as we know it.

Scientific and technological advances cannot postpone forever the inevitable issue of rising world population and the subsequent demands placed upon finite food, water, air, metals and fossil fuels resources or the pollution problems incident to increasing population size. The question of genetic manipulation cannot be left to a few researchers to decide. Science and technology are very much a part of our society and to ignore this fact, only results in continued dilemma. What is needed to rectify this situation is a society able to understand and participate in public and personal decisions affecting or affected by our limited resources, increasing population, pollution, genetic manipulation and other issues of science and technology.

The issues of population and its control, pollution and what one is willing to give up to maintain it at an "acceptable" level, the finite

fossil fuels and our dependence upon them, and the possibility of creating identical humans (cloning), are laden with values. The goal of the activities is to sensitize students to some of the issues with which they will have to deal as adults. Learners are presented with example situations involving such issues and asked to study their values and attitudes related to the issues, and make mock decisions pertaining to them. A science background is not a prerequisite for participation in the decision-making activities; however, the activities fit well in science courses. In addition, the series of activities are designed for anyone affected by possible scientific and technological decisions or who through public or personal decisions may affect the issues of science and its use. Several situations dealing with the ethics of science and the uses to which its findings have or may be put are provided below. There are several different ways in which the situations can be used to help students clarify values and make decisions. The procedure described herein is but one such way.

1. Choose one situation from those provided (perhaps a relatively "easy" one first) to follow through with an entire group of students. Using the decision-making steps listed below, examine the issue and the possible alternatives. Although it is impossible to implement a plan of action and assess the results, such a possibility can and should be discussed with students.
2. Now examine closely in a large group, small group or individually what values played a part in the decision-making. This could be done as a discussion or in written form.
3. Break up the class into groups, and have each group choose an issue situation with which to work from those supplied. Each group should work through the decision-making process. While

STAGES IN THE DECISION-MAKING PROCESS

FACTS/GENERALIZATIONS

Identify Decision Occasions and Alternatives

(a) define the decision to be made
(b) identify the goals of the decision maker
(c) identify available alternatives

Examine and Evaluate Decision Alternatives

(a) examine the probable outcome of each alternative
(b) evaluate and rank the alternatives

Decide and Reflect on the Decision

(a) select an alternative
(b) implement the plan of action
(c) assess the results of action
(d) consider recycling the process

VALUES/FEELINGS

(1) Cassidy, Edward W. and Kurfman, Dana G. "Decision Making as Purpose and Process." In 47th National Council of Social Studies Yearbook. Dana Kurfman, Editor. NCSS, Arlington, Virginia. 1977. page 7.

working through the process the groups should justify their decisions and examine their values as they are connected with the decisions they make. In some cases, the groups or individuals will have to research an issue in order to make a decision. Students should be encouraged to use commonly available sources such as Time, Newsweek, newspapers and Scientific American as well as their science text.

4. Be sensitive to student views. Refrain from judgmental statements concerning student opinions and do not impose your views on students. Be a facilitator not a lecturer. Because you can not know how personally involved students may be with these topics, be willing to excuse students

from any discussion that they feel is too much to handle at the time.

Situations

1. "All females, at birth should be issued coupons that would entitle them to give birth to two children. Coupons could be sold, traded or otherwise used or accumulated to allow for family size variation. Persons found in violation of this law would be rendered sterile by the accepted medical procedure." (Bridges, James A. "The Teaching of Life-Line Ethics." The American Biology Teacher 39: 243; April 1977.)

2. Biologists want to experiment with recombinant DNA. Recombinant DNA means splicing part of the DNA molecule of heredity from one form of life into the genetic material of another form. Biologists hope to give birth in the laboratory to what the process of evolution takes millions of years to accomplish, the creation of new species of life. The scientists who oppose recombinant DNA experiments say the area of ignorance about DNA and heredity is so vast we risk opening a Pandora's Box of problems for mankind. The benefits include the possibility of curing genetic defects, unlocking the secret behind control of genetic expression which may answer questions on cancer, developing higher quality protein yeilding plants which grow at a faster rate and alleviate world hunger, and cleaning up oil spills with a special bacteria able to

metabolize petroleum hydrocarbons exclusively. The opponents cite the lack of knowledge about the consequences of creating new life forms. A bacterium could be created against which humans have no defense. Whole populations could be destroyed. Also there is the risk of human error and possible changes in the environmental balance (3). Should experimentation with recombinant DNA be abolished, limited and, if so, by, whom, or, left open to researchers to experiment as they desire?

3. "Society needs energy and prefers the most economical and abundant source of energy. Nuclear and atomic energy seem to be an answer to society's needs in the light of dwindling supplies of coal, oil and gas and the over-taxed sources of water-based electric power..." (Sonneborn, T.M. "Secondary School Preparation for Making Biological Decisions." NASSP Bulletin. 360: 12; January 1972.)

However, using atomic energy involves risks to all forms of life including human life and health including genetic damage. How much risk are we willing to tolerate? How much should we worry about long-term consequences on other organisms and future humans?

4. Long before birth, Downs' Syndrome (Mongolian idiocy) can be predicted with 100 percent accuracy. One pregnant woman in about 600 carries such a baby. If a couple has previously had one such child, their chance of producing another is increased greatly. A pregnant woman of 40 or over

has about one chance in 50 of having a Mongolian idiot. However, all couples can have children free from this defect. There is no known cure of Mongolian idiocy. Some prevention would be possible if high-risk parents avoided reproduction altogether. This also keeps such parents from having children free of the defect; children they are capable of producing. If they took advantage of prenatal detection and then aborted the fetus if defective, they could try again until a fetus free of this defect was produced. Should they be allowed to have this choice? (4).

5. There is a finite amount of fossil fuel. Depending on which statistics we choose to believe, we have from ten years to several decades supply left. The point is that the supply is finite. We depend upon fossil fuels such as coal, gas and oil. Alternative sources of energy are not developing at a rate adequate to replace fossil fuels. What steps are we willing to take to cut down our fossil fuel consumption? Shall we mandate small cars? Shall we limit fossil fuel consumption per household or per industry?

By practicing making decisions about difficult but realistic problems and by analyzing the values connected with each decision, your students as adults may be more capable and more likely to carefully weigh alternatives before making decisions. Such practice should make them better prepared to vote and speak on issues of science and technology as well as other issues.

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